

# 4.0 BENEFITS OF HIGH-SPEED TRAINS

## 4.1 Benefit Cost Analysis: Benefits to High-Speed Train Passengers and the Traveling Public

### Overview

The high-speed train system will be a statewide transportation project on the scale of the freeways and the state water projects. It will transform the way in which people travel between cities in California, offering travelers the choice of driving, flying, or using high-speed trains. The high-speed train system will benefit the state in a number of ways. Many of the benefits are quantifiable and can be estimated based on detailed ridership and revenue forecasts. For projects such as the high-speed train system that require public investment, if these benefits are greater than the total costs, then the project is said to be economically justified.

In the private sector, a project is said to be commercially feasible only if commercial revenue exceeds costs paid directly by the project developer. For projects requiring public investment, a more appropriate evaluation tool is benefit cost analysis, which compares the total benefits to the total costs of a project. Benefit cost analysis includes all benefits and costs accruing to the public at large as well as the project developer. If the total benefits exceed the total costs, the project is said to be economically justified or economically feasible.

This analysis includes only those benefits and costs which are quantifiable, monetizable, not duplicative, and not transferred from one group of society to another. More specifically, the benefits include:

- Intercity passenger revenue;
- Benefits to both intercity and commuter high-speed train passengers (net of fares paid);
- Reduction of airside delay for air passengers; and
- Reduction in aircraft operating costs.
- Reduction of highway delay for both intercity and urban auto trips; and
- Reduction of accident costs and air pollution from intercity and urban auto trips

Costs include all the construction, operation and maintenance costs for the intercity passenger service.

Through the year 2050, California will accrue over \$44 billion in directly measured benefits from a high-speed train system — more than double the total costs using the “highest return on investment” high-speed train route used for the funding scenario. These benefits are more than double the total costs (*Table 4.1*). Not only high-speed train passengers will benefit from the system. In fact, most of the benefits will be enjoyed by air and auto travelers in the form of reduced delays, reduced air pollution, and reduced auto accidents and fatalities. The benefits will extend to interstate and even international travelers at California’s major airports.

The computation of the benefits directly utilizes the ridership and revenue forecasts for the high-speed train service and is consistent with the Federal Railroad Administration’s high-speed ground transportation commercial feasibility study<sup>1</sup>. Conservative assumptions were used throughout. The analysis is not exhaustive in its evaluation of benefits. For

<sup>1</sup> Federal Railroad Administration, “High-Speed Ground Transportation for America,” September 1997

Total Benefits	\$44.2 (billions, \$1999)*
Total Costs	\$21.5 (billions, \$1999)*
Net Present Value	\$22.7 (billions, \$1999)*
Benefit/Cost Ratio	2.06

\* Discounted at 4 percent

Note: Exclude benefits from development around stations, construction impacts, energy savings, potential freight revenues and potential savings from reduced conventional rail operations.

Table 4.1  
Summary of Benefit Cost Analysis Results (Through 2050)

example, no attempt was made to quantify the potential reductions in airport ground access congestion. In keeping with the policy of incorporating only “investment quality” numbers, surplus revenue from the express commuter service and high-speed freight service were not included in the analysis. Likewise, no potential operating cost savings or benefits to conventional rail passengers who take advantage of the high-speed train service were included in the analysis.

The estimated streams of benefits and costs occurring each year between FY 2001 and FY 2050 were discounted to their present value and summarized to calculate the benefit cost ratio (see Table 4.2 and Figure 4.1). Benefits would begin with the opening of the system to riders on July 1, 2016 (the beginning of FY 2017) and continue through FY 2050, allowing 33 years of economic returns for the high-speed train project. This time frame is similar to the typical 35-year franchise payback period used for privately financed toll road projects.

The discount rate is a means of calculating a value now of benefits that occur in the future. The discount rate recognizes the time value of money. A 4 percent real discount rate was used in the calculations. However, the high-speed train project would be economically feasible even under the higher discount rates recommended by some public agencies and economists. An evaluation measure that is independent of any chosen discount rate is the Internal Rate of Return (IRR). The IRR is the real discount rate at which the net present value of a project is equal to zero. This measure can be thought of as the discount rate threshold at which the project is no longer economically feasible. The real IRR for the high-speed train project is 8.8 percent. Thus, the project remains economically feasible even at real discount rates well above 4 percent.

The following sections present additional detail on the calculation of each category of benefits.

Intercity Passenger Revenue

In a publicly financed project, passenger revenue reduces the costs that must be funded from other sources. However, in a benefit cost analysis, passenger revenues are counted as a benefit. The present value of the intercity passenger revenue totals over \$9.6 billion, about 22 percent of the total benefit between 2017 and 2050 (see Figure 4.2).

BENEFITS		(MILLIONS)
Passenger Revenue		\$9,651
Benefits to High-Speed Train Passengers		
Intercity		\$8,519
Urban		\$317
Subtotal-Passenger Benefits		\$8,835
Benefits to Air and Highway Travelers		
Intercity		
Airline Passenger Delay		\$7,765
Aircraft Operating		\$4,283
Highway Delay*		\$3,540
Highway Accident Cost*		\$780
Highway Air Pollution*		\$103
Subtotal		\$16,471
Urban**		
Highway Delay		\$8,822
Highway Accident Cost		\$326
Highway Air Pollution		\$43
Subtotal		\$9,192
Subtotal-Nonuser Benefits		\$25,662
TOTAL BENEFITS		\$44,149
COSTS		
Capital		(\$15,443)
Operating and Maintenance		(\$6,015)
Total Costs		(\$21,458)
Total (Net Present Value)		\$22,690
Benefit/Cost Ratio		2.06
Internal Rate of Return		8.8%

\*Outside the Los Angeles, San Francisco and San Diego metropolitan areas.

Table 4.2  
Results of Benefit Cost Analysis  
(Present Value in \$1999, Discounted at 4 Percent, through 2050)

Through the year 2050, California will accrue over \$44 billion in directly measured benefits from a high-speed train system.

## Benefits to High-Speed Train Passengers

Most intercity high-speed train passengers will value the benefits from traveling on these high-speed, comfortable, and safe trains more than the fares they paid to ride the system. This value, measured as the difference between the fares paid by passengers and the amount they would be willing to pay, is also known as consumer surplus. Benefits to induced travelers were not included as a conservative assumption.

The consumer surplus for intercity high-speed train passengers has a present value of \$8.5 billion, or about \$34 per intercity passenger in the year 2020. Notably, the consumer surplus is nearly as large as the passenger fare revenue. This result reflects a fare policy assumed by the Authority that maximizes public benefits while maintaining a healthy operating surplus.

In urban areas, commuters who use high-speed trains will save time over the previously available travel modes. The present value of the travel time savings for commuters is about \$317 million.

## Benefits to Intercity Air Passengers

Californians who continue to travel by air will also benefit from the high-speed train system. Over the next 20 years, at least three airports in California, including San Diego's Lindberg Field, Los Angeles International, and San Francisco International, are predicting "unacceptable" delays. By diverting some passengers to high-speed trains, the system will reduce the otherwise expected delays in major airports. These reductions in delay will, in turn, reduce aircraft operating costs. At California's nine largest airports<sup>2</sup> the present value of these benefits is estimated at over \$12 billion.

There is considerable uncertainty with respect to airport expansion in California because of noise pollution and other environmental concerns. Nonetheless, the delay calculations assumed the planned capacity improvements and expansions listed in the airports' planning documents. Other conservative assumptions included a cap on total average airside delays of 15 minutes per aircraft, and an assumed

<sup>2</sup>These include Burbank, Los Angeles International, San Francisco International, John Wayne (Orange County), San Diego International (Lindberg Field), San Jose International, Ontario International, Sacramento International, and Oakland International Airports.



Figure 4.1  
Quantified Benefits vs. Costs (Through 2050)

shift of air passengers from congested airports to nearby airports with remaining capacity (i.e., passengers would shift from LAX to Burbank and from SFO to Oakland). The estimated benefits to air passengers do not include savings from potential reduced ground access congestion at these airports. In addition, based on the Federal Aviation Administration's growth rate forecasts, the average number of passengers per aircraft was assumed to increase by 50 percent from 1997 to 2016, and by 80 percent from 1997 to 2050.

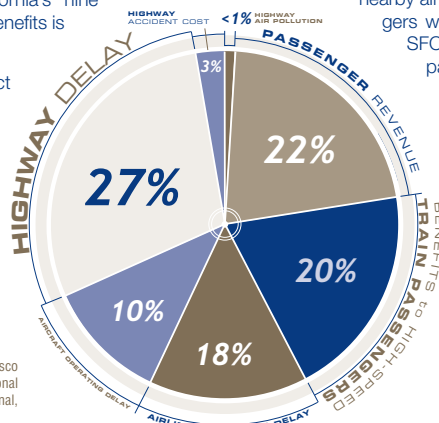


Figure 4.2  
Breakdown of Present Value of High-Speed Train Benefits

## Highway-Related Benefits

Both intercity and urban highway users will benefit from reduced highway congestion as a result of trips diverted to high-speed trains. By making fewer intercity trips by auto than they otherwise would have, Californians will also benefit from reduced accidents and air pollution. These highway-related benefits have a present value of over \$13.6 billion, with reduced highway delays being the most significant benefit.

### Intercity Highway Benefits

Benefits to intercity auto travelers outside the Los Angeles, San Francisco Bay Area and San Diego metropolitan areas have a present value of over \$4.4 billion with the present value of reduced highway delay outside the three major metropolitan areas over \$3.5 billion and accident and pollution costs valued at over \$883 million. These estimates of travel time savings or delay reduction for intercity travelers involved analysis of key intercity highway links in California, and took into account planned expansions of the highway network on State Route 99, Interstate 580, and Interstate 5 among other routes.

### Urban Area Highway Benefits

Commuters and other highway users will obtain benefits from commuter and intercity highway users diverting to the high-speed trains in the Los Angeles, San Diego, and San Francisco Bay Area regions. The present value of these urban highway-related benefits is over \$9 billion. The benefits from reduced urban auto travel in these regions was estimated using the travel demand models maintained by regional planning agencies.

perspective on the benefits provided by high-speed trains.

## Development Around Stations

High-speed rail is a mode of transportation that can enhance and strengthen urban centers. In combination with appropriate local land use policies, the increased accessibility afforded by the high-speed service could encourage more intensive development and may lead to higher property values around stations. Although the financial plan does not assume that any of this revenue is available to help construct the system, local authorities may realize some of this gain in value through various value capture techniques such as benefit assessment districts or tax increment financing. Revenue in the range of \$730,000 to \$1.8 million per year at each potential station site might be realized through development.

## Construction Impacts

The short-term impacts of constructing the system should not be ignored. While construction of the system will require a large capital investment, this investment translates into jobs and industrial output in California. System construction expenditures will produce the following types of effects:

- Direct Economic Effects — activity generated at firms directly receiving the construction spending;
- Indirect Economic Effects — activity generated by the successive rounds of off-site purchases from suppliers of materials and services; and
- Induced Economic Effects — activity generated as a consequence of additional worker income being re-spent on consumer purchases.

## 4.2 Benefits Not Included in the Benefit Cost Analysis

This section discusses some of the additional benefits associated with the high-speed train system. The dollar values of most of the benefits described in this section should not be added to the results of the benefit cost analysis to avoid double counting. Instead, this discussion is intended to add a different

**Both intercity and urban highway users will benefit from reduced highway congestion as a result of trips diverted to high-speed trains.**

The direct, indirect, and induced economic impacts will occur in four basic forms:

- Industry output — the dollar value of industry's total production;
- Job-years — the number of jobs supported in each industry;
- Personal income — all individual income generated as a result of increased industry output; and
- Taxes — all taxes generated as a result of added industry output.

Construction of the high-speed train system is estimated to generate the equivalent of almost 300,000 job-years of employment. In addition, the construction spending is estimated to generate in present value over \$11 billion in personal income, almost \$28 billion in industrial output, and \$871 million in tax revenue. The industries in California that are expected to benefit most include construction (\$10.4 billion in total added output), services (\$6.6 billion in added output), and manufacturing (\$2.7 billion in added output). Some portion of the labor and construction spending may, of course, occur outside of the state, but the bulk of the effect is expected to occur in California. Furthermore, the system will generate thousands of permanent jobs through the ongoing operations of high-speed trains.

### Freight Revenue

The high-speed infrastructure offers great flexibility and potential in the type of services it can support. In addition to passenger traffic, the high-speed infrastructure could also be used to transport high-value/time-sensitive goods within the state. Preliminary analyses have shown that two types of freight service are possible. One type of service would involve transport of small packages and parcels on the passenger trains. The other type of service would involve running dedicated medium-weight, high-speed freight trains on the infrastructure during night hours. Although the ultimate specifications of any freight service are yet to be determined, the prospects for carrying freight on high-speed trains are very good. Accordingly, the financial plan includes a conservatively estimated \$4.1 million in surplus freight revenue in 2017, ramping up to \$34.1 million annual freight revenue by the year 2045. The freight revenue included in the financial plan comes only from small packages and parcels carried on the passenger trains. Freight revenue is a benefit not only in that it enhances the operating margins of the system but also in that the infrastructure would be used more

intensively. In addition, there is value in having another option for carrying high-value/time-sensitive goods throughout the state.

### Benefits Not Quantified

In addition to those benefits described above, the high-speed train system will bring other opportunities and benefits to the state that cannot be quantified. First and foremost, the high-speed infrastructure represents a major transportation capacity improvement that can be tapped by future generations in ways as-yet unimagined. The economic vitality and stability of California has depended historically on the ability to move people, goods, and information freely and efficiently between population centers, agricultural markets, and ports of entry. This improvement to the statewide infrastructure will support commuter as well as intercity passenger traffic and high-speed freight service. High-speed trains will complement and connect to airports and highways, providing a substantially greater degree of mobility for those who travel in California.

Second, the high-speed train system will promote stability through diversity in California's transportation network. High-speed trains will provide a third option for intercity travel, giving Californians the choice of using airplanes, autos, or high-speed trains. The high-speed train system can reduce California's dependence on fossil fuels for intercity travel since it will use electric power traction. In the face of a natural disaster, high-speed trains would offer insurance against major disruptions to intercity travel, much as the BART system provided mobility after the 1989 Loma Prieta earthquake. For the Central Valley, a high-speed train system would eliminate much of the uncertainty and unreliability of both air and highway travel resulting from ground fog and other climatic conditions present at certain times.

**Construction of the high-speed train is estimated to generate the equivalent of almost 300,000 job-years of employment.**

Third, the high-speed train system can act as a catalyst to strengthen urban centers, promote more compact development around stations, and even increase local property values. The high-speed train system will provide a means to directly access urban centers, bypassing the congested roadways leading from airports and intercity highway corridors. It will also improve service to central city employment centers, and to residents and groups with low auto availability (whether by choice or necessity). In concert with suitable local land use and economic development policies, high-speed trains can strengthen existing city centers by maintaining and improving accessibility.

Lastly, high-speed trains would enhance the quality of California as a place to live and do business. The advanced technology involved in constructing and operating the system — everything from the latest in signaling, communications, and controls systems to the most advanced structural engineering techniques — is consistent with California's leadership in high technology. Implementation of the high-speed train system would show that the state is committed to making the infrastructure investments necessary to sustain economic growth and improve the quality of life of its citizens.

